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Performance evaluation of early maize genotypes in far western hills of Nepal

Hari Kumar Prasai[1*], Ujjawal Kumar Singh Kushwaha[1], Bishnu Prasad Joshi[1] and Jiban Shrestha[2]

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ABSTRACT

Initial evaluation trial of maize (early) genotypes was carried out at Regional Agricultural Research Station, Doti, Nepal in 2013 and 2014. Total fourteen and fifteen genotypes of early maize were included in initial evaluation experiment of the year 2013 and 2014 respectively. The experiment was laid out in randomized complete block design (RCBD) with three replications in each year. Out of the tested genotypes, SO3TEY/LN, ZM 423 and SO3TEY-FM (ER) identified as promising from statistical analysis over year. All the tested characters were found statistically significant. Similarly, the coordinated varietal trial of maize (early) was also carried out in the same station at 2013 and 2014. Total fourteen genotypes in 2013 and fifteen genotypes in 2015 of maize (early) were included in the experiment. The RCB design was applied and the experiment was replicated three times in every year. ZM 627 and ZM 621/Pool -15 genotypes identified as superior next to Arun-2 from the analysis of two year data. All the tested traits were found statistically significant in over year analysis.

INTRODUCTION

Maize (*Zea mays* L.) occupies second largest cultivated area (849635 ha) after rice (1420570 ha) in the country. Out of the total cultivated area of cereal crops (3339077 ha), the share of maize cultivation is 25.44%. The contribution of agriculture and forestry sector in GDP is 34.74% and 65.6% population are being engaging in agriculture sectors. National average productivity of maize is 2353 kg/ha (MoAD, 2013). Amongst the total cereal production of the country (8580285 mt), the contribution of maize is 23.29%. The status of maize cultivation and production in far western development is different. Maize is being cultivating in 45846 ha and it falls under third crop after rice (160701 ha) and wheat (140844 ha) in far western development region of the country. The average productivity of maize in this development region is 1831 kg/ha which is 22.18% low compared to the national average productivity. The contribution of maize in total cereal productionis about 10% and it occupies 12 % cultivated area of the total cereal cultivated area of far western development region (MoAD, 2013). Maize cultivation is a way of life for most farmers in the hills of Nepal (Adhikari, 2000).

Corresponding author Info:
*1Regional Agricultural Research Station, Bhagetada, Doti, Nepal 2National Maize Research Program, Rampur, Chitwan, Nepal *E-mail: hkprasai60@gmail.com*

It is traditional crop cultivated as food, feed and fodder on slopping Bari land (rainfed upland) in the hills. It is grown under rainfed condition during the summer (April-August) as a single crop or relayed with millet in the later season. In the terai, inner terai, valleys and low-lying river basin areas, maize is also grown in the winter and spring with irrigation (Paudel *et al*., 2001). Maize is cultivated in a very diverse environment in Nepal (NPC, 1994). Maize has feature that has contributed to its broad morphological variability and geographical adaptability. Maize can be classified based on environment in which it is grown, maturity class and use (Yanli Lu et al, 2009). Maize exhibits extensive genetic variation (Buckler and Stevens, 2005).Besides other factors, biotic and abiotic stresses are supporting to limit the maize yield in many developing countries (Prasana, 2012). Production may not be able to meet the demand without technological and policy interventions (Shifegrowth *et al.*, 2011). Another important challenge that threatens the long term production growth of maize is the changing global climate (Cairns *et al.*, 2012).Far western development region is the drought prone region of the country. Farmers of far western hills prefer early maturing varieties suitable to their existing cropping system. Unavailability of high yielding genotypes of maize suitable to agro-climatic condition of far western development region is one of the reasons of low productivity of maize in this region. So this research was carried out to identify the high yielding and early maturing genotypes of early maize.

Description of the experimental site

Regional Agricultural Research Station, Bhagetada, Dipayal, Doti is located in far western development region of the country. This research station is situated at an altitude of 610 meter above sea level with $29^0$15' north latitude and $80^0$55' east longitude. This research station represents for river basin agro-environment of far western hills and generally annual rainfall is less than 1000 mm, but year round irrigation facility is available (Anonymous, 2012).

MATERIALS AND METHODS

The RCB design was applied in seeding initial evaluation trial (IET) of maize (early) in both year (2013 & 2014). This experiment was replicated three times in each year. Total fourteen and fifteen genotypes of maize (early) were included in initial evaluation experiment of 2013 and 2014 respectively. The gross plot size was maintained by 6 m^2 and harvested plot size was also same. The experiments of both years were seeded at the spacing of 75 cm row to row and 25 cm plant to plant. Those genotypes which were similar in initial evaluation experiment of both year (2013 and 2014) were included in analysis over year. Only ten genotypes were included in combined analysis over year, they are: SO3TEY-FM(ER), SO3TEY-SEQ, Across-2401, SO3TEY/LN, ACO-2401/ACO-2402, Rampur SO3EO2, Arun-1, EEYC1, ZM 621/Pool-15 and ZM 423.The coordinated varietal trail of maize (early) was carried out in 2013 and 2014 at RARS, Doti. The experiment was laid out in RCB design in both years. The experiment was replicated three times in every year. The gross plot size was maintained by 12 m^2 and net harvested plot size was of 6m^2 in both years. The experiments of both years were seeded in 75 cm row to row spacing and 25 cm plant to plant spacing. The genotypes included in the experiment of 2013 were: POP 445, POP 446, S97TLYGH "AyB" (3), POP 445/POP 446, POP 45/Pool17, Rampur composite/Pool-17, POP 44/Pool 15, Arun-2, Farmers' variety, ZM 627, ZM 621/Pool-15, EEYC1, ZM 423 and Pool-27. Similarly, the genotypes included in coordinated varietal experiment of 2014 were: Across 2401, Rajhar Local, S97TLYGH"AyB' (3), POP 445/POP 446, Arun-1EV, Rampur composite/Pool-17,

SO3TEY/LN, Arun-2, Farmers' variety, ZM 627, ZM 621/Pool-15, EEYC1, Khumal yellow/Pool-17, Pool-27 and Pool-15. Total nine genotypes which were included in both years' experiment were incorporated in over year analysis, they are: S97TLYGH"AyB" (3), POP 445/POP 446, Rampur composite/Pool-17, Arun-2, Farmers' variety, ZM 627, ZM 621/Pool 15, EECY1 and Pool-23. The CVT and IET sets were obtained from National Maize Research Program, Rampur, Chitwan, Nepal. The fertilizer was applied at the rate of 120:60:40 NPK kg/ha in both IET and CVT. Half dose of nitrogenous fertilizer and full dose of phosphorus and potash was applied as basal dose and remaining half dose of nitrogenous fertilizer was applied in two split doses, that is, after first and second hoeing. The seed sowing was done at the rate of 20 kg/ha and both experiments were carried out in summer season. Irrigation was supplied as per the need of the crop. Furadon was applied at the rate of 20 kg/ha to control stem borer. Data of days to tasseling, days to silking, plant height, ear height and grain yield were recorded and analyzed by using Excel and MSTATC software.

RESULTS AND DISCUSSION

Out of the genotypes included in the coordinated varietal experiment of 2013, the longest anthesissilking interval (ASI) was observed in ZM 423 (4.33 days) whereas the shortest ASI was found in ZM 627 (1.66 days). POP 45/Pool 17 genotype was found tallest in plant height (262.67 cm) and ear height (119.33 cm) whereas S97TLYGH"AyB"(3) (198.33 cm) and POP 445/POP 446 (199 cm) identified as dwarf genotypes of maize (early). Although standard check variety, Arun-2, recorded the highest grain yield (4067.83 kg/ha), POP 445 (3876.77 kg/ha) and EEYC1 (3847.87 kg/ha) identified as superior genotypes of maize (early) in the CVT experiment of 2013 (Table 1). Statistically, all the traits tested in the experiment were found significantly different due to genotypes.

Table 1. Performance of maize (early) genotypes in coordinated varietal trial at RARS, Doti during 2013.

SN	Genotype	Day to tasseling	Day to silking	Plant height (cm)	Ear height (cm)	Grain yield (kg/ha)
1	POP 445	42.33	45.67	233.00	76.67	3876.77
2	POP 446	43.00	45.33	227.00	81.00	3742.80
3	S97TLYGH"AyB" (3)	41.00	44.00	198.33	71.67	2914.63
4	POP 445/POP 446	40.67	44.33	199.00	69.33	2740.47
5	POP 45/Pool 17	43.00	45.67	262.67	119.33	3029.50
6	Rampur Composite/Pool -17	43.33	45.67	231.33	104.33	3331.50
7	POP 44/Pool-15	46.33	48.67	242.00	97.00	3435.67
8	Arun-2	43.67	46.33	245.67	105.67	4067.83
9	Farmers' Variety	31.67	34.67	226.00	72.69	2023.01
10	ZM 627	52.67	54.33	235.67	99.00	2978.22
11	ZM 621/Pool 15	44.33	46.46	215.67	85.00	3692.17
12	EEYC1	44.00	47.00	239.00	93.67	3847.87
13	ZM 623	52.00	56.33	259.00	104.33	3504.43
14	Pool 27	41.33	45.33	235.67	104.00	3345.70
	F-test	**	**	**	**	**
	CV %	3.79	2.98	6.70	9.24	15.52
	$LSD_{0.05}$	2.77	2.32	26.11	14.23	862.37

National Maize Research Program, Rampur, Chitwan, Nepal had discarded some genotypes from CVT set of 2013 and had included some new genotypes in CVT sets of 2014. Amongst the tested genotypes, the shortest ASI (2 days) was found in POP 445/POP 446 while the longest ASI (3.67 days) was found in ZM 621/Pool 15 and Arun 1 EV. The highest plant height (264.33 cm) was observed in Pool 15 whereas Across 2401 recorded the lowest plant height (197.33 cm). Out of the genotypes included in the experiment of 2014, SO3TEY/LN produced the highest grain yield (5292 kg/ha). ZM 627 identified as superior genotype by producing 4709.67 kg/ha grain yield, though the grain yield was 4.56% low compared to the grain yield of standard check variety, Arun-2 (4934 kg/ha). Statistically, all the tested characters were found significantly different due to genotypes (Table 2).

Table 2. Performance of maize (early) genotypes in coordinated varietal trial at RARS, Doti during 2014.

SN	Genotype	Day to tasseling	Day to silking	Plant height (cm)	Ear height (cm)	Grain yield (kg/ha)
1	Across-2401	54.67	57.33	197.33	72.00	1446.33
2	Rajhar Local	53.67	56.67	272.33	136.33	3358.00
3	S97TLYGH"AyB"(3)	46.00	48.67	228.00	96.00	4024.00
4	POP 445/POP 446	45.67	47.67	225.67	103.00	4029.00
5	Arun 1 EV	48.00	51.67	248.00	122.67	3693.33
6	Rampur Composite/Pool 17	51.67	53.67	243.00	112.33	2710.67
7	SO3TEY/LN	52.67	54.67	243.33	123.33	5292.00
8	Arun-2	49.67	52.00	256.00	120.33	4934.67
9	Farmers' variety	44.00	46.33	235.67	103.00	3171.67
10	ZM 627	56.00	59.00	246.67	108.67	4709.67
11	ZM 621/Pool-15	50.33	54.00	240.67	102.67	3844.33
12	EEYC1	50.00	52.67	238.67	106.00	3868.67
13	Khumal Yellow/Pool-17	50.00	52.67	259.33	113.33	4076.33
14	Pool-27	49.67	52.33	245.67	111.33	3802.00
15	Pool-15	49.00	52.00	264.33	131.00	4142.33
	F-test	**	**	**	**	**
	CV %	3.23	2.77	6.80	10.71	13.96
	$LSD_{0.05}$	2.71	2.43	27.65	9.84	888.79

Analysis over year was done of those genotypes which were included in the experiment of 2013 and 2014. The shortest ASI (2.17 days) was found in S97TLYGH "AyB' (3) and

Rampur composite/Pool-17 whereas ZM 621/Pool-15 showed the longest ASI (3 days). The highest plant height (250.83 cm) and ear height 113 cm) was observed in standard check variety, Arun-2. Although, Arun-2 produced the highest grain yield (4501 kg/ha), ZM 627 and ZM 621/Pool-15 identified as superior genotypes with the grain yield production of 3753 kg/ha and 3778 kg/ha (table-3). All the tested characters were found significantly different due to genotypes and genotype by year in over year analysis.

Out of the fourteen and fifteen genotypes of maize (early) included in IET experiment of 2013 and 2014, only those genotypes which were incorporated in IYT experiment of both years were taken for over year analysis. Only the over year analysis of two year data of IET has been presented in this paper. The shortest days to tasseling (46.67) and silking (49.67) was observed in EEYC1 whereas the longest days to tasseling (51.83) and silking (54.83) was found in ZM 423. The highest plant height (268.17 cm) and ear height (130.17 cm) was observed in standard check variety, Arun-1. SO3TEY/LN produced the highest grain yield (5572.33 kg/ha) followed by ZM 423 (5268.33 kg/ha) and SO3TEY-FM (ER) (4922 kg/ha)

in the analysis of two year experimental data. Statistically, all the tested characters were found significantly different in over year analysis (Table 4). Pokhrel *et al.* (2014) also agreed with SO3TEY-FM (ER) as the promising genotype of early maize for river basin areas of mid-western hills of Nepal.

Table 3. Grain yield and other ancillary characters of maize (early) in over year analysis (2013 and 2014) of coordinated varietal trial at RARS, Doti

SN	Genotype	Day to tasseling	Day to silking	Plant height (cm)	Ear height (cm)	Grain yield (kg/ha)
1	S97TLYGH"AyB"(3)	43.50	45.67	213.17	83.83	3469.00
2	POP 445/POP 446	43.17	46.00	214.00	86.17	3368.17
3	Rampur Composite/Pool-17	47.50	49.67	237.17	108.33	3019.17
4	Arun-2	46.67	49.17	250.83	113.00	4501.00
5	Farmers' variety	36.33	39.17	230.83	87.83	2430.50
6	ZM 627	54.33	57.17	241.17	103.83	3753.67
7	ZM 621/Pool-15	47.33	50.33	228.17	93.83	3778.00
8	EECY1	47.00	49.67	238.83	99.83	3287.00
9	Pool-27	45.50	48.83	240.67	107.67	3423.67
	Genotype (G)	**	**	**	**	**
	Year (Y)	**	**	**	**	**
	G × Y	*	**	NS	NS	**
	CV%	3.19	2.80	6.29	9.73	8.24

Table 4: Grain yield and other ancillary characters of maize (early) in over year analysis (2013 and 2014) of initial evaluation trial at RARS, Doti

SN	Genotype	Day to tasseling	Days to silking	Plant height (cm)	Ear height (cm)	Grain yield (kg/ha)
1	SO3TEY-FM(ER)	48.33	50.83	240.67	110.33	4922.00
2	SO3TEY-SEQ	47.83	50.67	234.50	97.17	4473.00
3	Across-2401	49.67	52.83	224.33	88.33	3260.33
4	SO3TEY/LN	50.00	52.83	254.00	117.00	5572.33
5	ACO-2401/ACO-2402	50.00	52.83	232.67	104.50	4784.50
6	Rampur SO3EO2	50.33	53.50	219.50	99.33	3385.50
7	Arun-1	47.83	50.67	268.17	130.17	3741.50
8	EEYC1	46.67	49.67	229.67	103.17	3888.33
9	ZM 621/Pool-15	47.00	52.00	220.83	92.00	3097.33
10	ZM 423	51.83	54.83	247.50	112.67	5268.33
	Genotype (G)	**	**	**	**	**
	Year (Y)	**	**	NS	NS	NS
	G × Y	NS	NS	NS	NS	**
	CV%	4.00	3.15	10.64	13.45	29.25

CONCLUSION

In CVT, although ZM 623 and ZM 621/Pool-15 were foundnext to standard check in grain yield production, they are emerging as superior genotypes for far western hills and are recommended to continue this experiment one year more to verify the stability of the experimental results. In IET, SO3TEY/LN, ZM 423, SO3TEY-FM (ER), ACO-2401/ACO-2402 and SO3TEY-SEQ genotypes were found promising for far western hills and is recommended to include in CVT for further varietal improvement program.

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